Assessing Responsiveness to RET by Individuals with Chronic Non-fluent Aphasia: A Clinical Perspective

Introduction

Response elaboration training (RET) is a "loose training" program designed to increase the length and information content of verbal responses of patients with aphasia (Kearns, 1985). Patients have responded robustly to RET regardless of severity level or type of aphasia (Wambaugh, Wright, and Nessler, 2012). One difficulty faced by clinicians seeking to use RET is participants in research studies have usually been treated at a frequency and for a duration that far exceeds standard clinical practice.

In order to examine RET from a "clinical perspective," the researchers carried out a selective meta-analysis of RET focusing on a "window of treatment" that would be commensurate with standard clinical practice.

Methods

Selection of participants for analysis

Data from 30 subjects with aphasia from 12 RET studies (See Appendix A) were examined individually. Subjects were included in the analysis if they had chronic non-fluent aphasia and if data were provided to permit the investigators to measure the number of content words generated in response to the picture stimuli of RET. Thirteen participants from six RET studies (See Appendix A) met these inclusion criteria. For convenience in discussing the results of the analysis, these subjects were separated into moderate (n=6) and severe (n=7) groups on the basis of their AQ scores of the *Western Aphasia Battery* (WAB: Kertesz, 1982) or their overall percentile ranking on the Porch Index of Communicative Ability (PICA; Porch, 1981). Table 1 provides relevant test, demographic, and other information on these individuals.

Measurement and reliability

Data from all probes administered during the baseline, treatment, and maintenance phases of the RET studies were examined by two different observers independently following procedures suggested by Beeson and Robey (2006). To determine changes in verbal output across the probes, the examiners used a ruler lined up with the *Y*-axis of graphs depicting probe data to estimate the mean number of content words produced per stimulus item on all probes. The two independent observers were considered to be in agreement if their estimates were within $\pm$ 0.20 on a single probe. If the two observers agreed but did not match identically, the lead author's estimates were used for the analysis. When the observers did not agree on their original measurements, agreement was obtained by consensus with both observers measuring the probe together.

Procedure of analysis

The magnitude of effect for treated and untreated items was calculated using procedures described by Beeson and Robey (2006). To estimate the effect size, comparison between pre-treatment and post-treatment periods was calculated using a variation of a *d* statistic:

$$d = \frac{\bar{X}_{A2} - \bar{X}_{A1}}{S_{A1}}$$

In this equation, the mean ($\bar{X}$) of the pre-treatment period ($_{A1}$) is subtracted from the mean of the post-treatment period ($_{A2}$) and the result is divided by the standard deviation (S) of the pre-treatment period.

Multiple baseline designs were used in the six RET studies examined in this investigation. For each participant, a set of picture stimuli (set 1) was treated to performance criteria while a different set (set 2) remained in baseline. After the performance criteria were met, treatment stopped for set 1 and was applied to set 2 until meeting the performance criteria for this set. A third set of untreated stimuli (set 3) was used to assess generalization.

Variations in the multiple baseline designs among the six RET studies made uniformly analyzing the post-treatment periods difficult. Unless the study provided post-treatment effect sizes, the maintenance phase was the preferred period to use for the post-treatment period ($_{A2}$) in this analysis. When maintenance phases were not included, an average of the last three clinical probes was used as the post-treatment phase for the set.

Results

To examine the impact of treatment on the 13 individuals who received RET, individual effect sizes were estimated for treated items (set 1, set 2, and sets 1 and 2 combined), untreated items used to assess generalization (set 3), and after the tenth treatment session for set 1 items.

Changes from pre-treatment to post-treatment for treated and untreated items

Positive treatment effects for virtually all set items were seen for the participants with moderate and severe non-fluent aphasia, as shown in Table 2. Larger effect sizes were seen for participants with severe aphasia for both trained and untrained items. Table 3 shows that individual effect sizes were medium or large for 10/12 (83%) or 8/12 (67%) participants for trained and untrained items, respectively.

Changes after ten treatment sessions

To examine RET effects over a period of treatment commensurate with standard clinical practice, the mean number of content words and effect sizes were determined after 10 treatment sessions using an average of the following two clinical probes. Table 4 shows changes in the mean number of content words from baseline to after the tenth treatment as well as changes in the mean number of content words from the tenth treatment to the last treatment session for set 1 items. Reported also in Table 4 are the estimated effect sizes for each participant following ten treatment sessions as well as the number of additional treatments administered after the tenth treatment session for set 1.

Overall, the effect sizes estimated after 10 treatments were larger for the participants with severe non-fluent aphasia.

The number of additional treatments from the tenth treatment session to the end of set 1 ranged from 5 to 40. During this period of treatment, some participants improve, others remained the same, and two participants declined. Overall, larger gains were seen in the mean number of content words produced following the tenth treatment session than in the period spanning from the tenth treatment to the final treatment. For instance, the mean number of content words produced after 10 treatments ranged from 0.05 to 10.69 and had an average from all participants of 3.59, whereas the difference in the mean number of content words between the tenth and last treatments for set 1 items ranged from -3.20 to 7.84 and had an average from all participants of 1.21.

Discussion

Results from this study provides support for use of RET with patients with a limited number of treatments. Although RET effects tended to be larger when treatment was continued to performance criteria levels, this study found positive treatment effects after just 10 treatments. Moreover, gains made after the tenth treatment were generally larger than the improvements seen from the tenth treatment to the final treatment for items in set 1.

Effect sizes were generally larger for individuals with severe aphasia. However, care should be taken in interpreting the practical significance of these results. The amount of variation produced in the responses during baseline had a strong influence on the participants' effect sizes.

This study was limited to examining the effects of RET on verbal utterances produced in response to picture stimuli by individuals with chronic non-fluent aphasia. This study could be improved upon by including data for responses produced without picture stimuli and from participants with fluent aphasia.

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Table 1. Participant characteristics and pretreatment testing results

Study	Participants n=13	Aphasia Severity	Aphasia Type	WAB AQ	PICA Percentile	Months Post-onset	Age	Gender	Years of Education
Kearns (1985, 1986)	P1	Severe	Broca's	---	46th	36	50	Male	Grade level
Kearns & Scher (1989)	P2	Severe	Broca's	35.4	45th	20	59	Male	16
Kearns & Yedor (1991)	P3	Moderate	Broca's	65	---	7	70	Female	8
	P4	Moderate	Broca's	61	---	37	61	Female	8
Wambaugh & Martinez (2000)	P5	Severe	Broca's	37	---	12	64	Male	14
	P6	Severe	Broca's	29.8	35th	25	62	Female	11
	P7	Moderate	Broca's	54.4	45th	20	63	Male	11
Bennett, Wambaugh, & Nessler (2005)	P8	Severe	Broca's	34.8	35th	30	38	Male	12
Wambaugh, Wright, & Nessler (2012)	P9	Moderate	Broca's	50.5	58th	96	56	Male	14
	P10	Severe	Broca's	38	45th	33	46	Female	12
	P11	Severe	Isolation	35.3	36th	33	56	Male	20+
	P12	Moderate	Broca's	71.2	64th	19	55	Female	13+
	P13	Moderate	Broca's	65.8	59th	42	64	Male	14

Moderate: WAB AQ= 51-74; PICA percentile = 50th -75th
Severe: WAB AQ = 26-50; PICA percentile = 30th-50th

Table 2. Changes from pre-treatment to post-treatment, effect sizes, and number of treatment sessions for all trained and untrained sets

Aphasia Severity	Set 1 (First Treated Picture Set)			Set 2 (Second Treated Picture Set)			Set 1 & Set 2 (Combined)		Set 3 (Generalization Picture Set)	
Moderate n=6	$\bar{X}_{A2} - \bar{X}_{A1}$	Effect Size (*d* statistic)	Number of Treatment Sessions	$\bar{X}_{A2} - \bar{X}_{A1}$	Effect Size (*d* statistic)	Number of Treatment Sessions	Effect Size (Weighted *d* statistic)	Number of Treatment Sessions	$\bar{X}_{A2} - \bar{X}_{A1}$	Effect Size (*d* statistic)
P3	3.59	7.41	30	3.43	6.36	25	6.95	55	3.25	6.47
P4	3.61	6.23	20	3.11	5.03	15	5.63	35	---	---
P7	6.95	5.38	26	---	---	---	---	---	---	---
P9	1.76	5.11	20	2.5	0.58	20	1.75	40	0.4	2.11
P12	7.49	3.69	16	9.28	16.19	14	12.54	30	3.01	2.28
P13	4.47	1.89	20	4.56	6.05	10	4.77	30	3.0	1.15
Severe n=7										
P1	3.65	12.66	15	4.55	3.87	6	8.89	21	2.53	19.15
P2	3.92	45.26	37	3.15	21.82	15	35.22	52	1.43	9.93
P5	13.39	64.03	30	14.03	43.05	13	54.42	43	13.66	118.63
P6	2.97	15.76	50	3.23	14.42	60	15.38	110	2.74	11.15
P8	5.99	13.10	CND	4.77	10.12	CND	11.82	CND	3.17	8.12
P10	2.35	6.76	20	5.09	19.45	20	14.01	40	0.74	4.16
P11	3.75	14.47	20	2.75	9.43	22	11.15	42	2.01	10.61

$\bar{X}_{A2} - \bar{X}_{A1}$ = difference in the mean number of content words between post-treatment and pre-treatment, per stimulus item; CND = cannot determine; --- indicates no data.

Table 3. Interpretation of effect sizes for direct treatment and generalization

Aphasia Severity	Participant	Direct Treatment (Set 1 & Set 2 Combined)	Generalization (Set 3)
Moderate (n=6)	P3	Large	Large
	P4	Medium	No treatment effect observed by Kearns & Yedor (1991)
	P7	---	---
	P9	No treatment effect	No treatment effect
	P12	Large	No treatment effect
	P13	Medium	No treatment effect
Severe (n=7)	P1	Large	Large
	P2	Large	Large
	P5	Large	Large
	P6	Large	Large
	P8	Large	Large
	P10	Large	Medium
	P11	Large	Large

Effect sizes: 2.6, 3.9, and 5.8 for small, medium, and large, respectively. Established by Beeson and Robey (2006) from values derived from single-subject studies in aphasia research.

Table 4. Changes after 10 treatments

Aphasia Severity	$\bar{X}10^{th}$ - $\bar{X}_{A1}$	Effect size after 10 treatments	$\bar{X}_{A2}$ - $\bar{X}10^{th}$	Number of additional RET treatments for set 1 items after the 10th treatment
Moderate				
P3	1.55	3.19	2.04	20
P4	1.60	2.76	2.01	10
P7	5.09	3.94	1.86	16
P9	1.49	4.63	0.27	10
P12	10.69	5.03	-3.20	6
P13	7.87	3.19	-3.40	10
Severe				
P1	3.58	12.41	0.07	5
P2	2.70	31.18	1.22	27
P5	5.55	26.53	7.84	20
P6	0.05	2.48	2.92	40
P8	CND	CND	CND	CND
P10	1.90	3.64	0.45	10
P11	0.95	3.70	2.80	10

$\bar{X}10^{th}$ - $\bar{X}_{A1}$ = difference between the mean number of content words following 10 treatments and the mean number of content words produced during baseline, per stimulus item for set 1; $\bar{X}_{A2}$ - $\bar{X}10^{th}$ = difference between the mean number of content words produced after the last treatment and the mean number of content words following 10 treatments, per stimulus item for set 1; CND = cannot determine.

Appendix A
RET studies examined for this study

Study	Number of participants (n=30)	Included in the analysis for this study (n=13)	Reason for exclusion
Kearns (1985, 1986)	n=1	Yes, n=1	
Kearns & Scher (1989)	n=3	Yes, n=1	The effects of RET were examined on two participants with fluent aphasia
Gaddie, Kearns, & Yedor (1991)	n=3	No	Individual participants could not be linked to the RET treatment data
Kearns & Yedor (1991)	n=2	Yes, n=2	
Wambaugh & Martinez (2000)	n=3	Yes, n=3	
Conley & Coelho (2003)	n=1	No	This study examined RET combined with SFA. Outcomes results could be distinguished between the two treatments.
Dunn (2004)	n=2	No	This study used pre-treatment and post-treatment testing as its primary measure and did not provide data for the effects of RET on the number of content words
Bennett, Wambaugh, & Nessler (2005)	n=1	Yes, n=1	
Nessler, Wambaugh, & Wright (2009)	n=2	No	This study examined the effects of RET on participants with fluent aphasia
Wambaugh, Nessler, & Wright (2012)	n=3	No	This study examined the effect of RET on procedural discourse and personal recounts without use of picture stimuli
Husak & Marshall (2012)	n=3	No	This study examined the effects of RET on syntax rather than number of content words
Wambaugh, Wright, & Nessler (2012)	n=6	Yes, n=5	The effects of RET were examined on one participant with fluent aphasia